Multi-Temporal vs. Hyper-Spectral Imaging for Future Land Imaging at 30 m

Completed Technology Project (2014 - 2015)

Project Introduction

We propose to determine the information content of multi-temporal land imaging in discrete Landsat-like spectral bands at 30 m with a 360 km swath width and compare this to the information content of hyper-spectral land imaging at 60 m with a swath width of 145 km. We will analyze 30 m visible and near infrared cloud-free data collected every two weeks for the entire continuous lower 48-sates in 2011 and 2012.

The extremely successful Landsat series of satellites have collected invaluable imagery of the Earth's surface since Landsat-1 was launched in 1972. Since 1982 with Landsat-4's thematic mapper instrument, 30 m multispectral imagery have been collected in discrete visible, near-infrared, and short wave infrared bands complemented by thermal imagery at coarser resolutions. Landsat-8, launched in 2013, and Landsat-7, launched in 1999 and since 2003 suffering from a lack of scan line corrections, are the sources of current US land imaging data. JPL and their associates have proposed the replacing the Landsat 30 m discrete multispectral visible, near-infrared, and short wave infrared imaging with hyper-spectral imagers, patterned after HyspIRI, a JPL instrument.

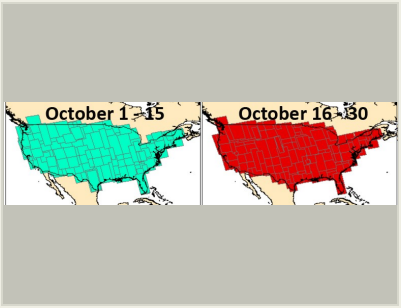
The argument hyper-spectral imager enthusiasts make for replacing a discrete band Landsat-type instrument is there is more information in hyper-spectral data, because you have so many more spectral bands. JPL's hyper-spectral HyspIRI instrument, scheduled for launch in 2016, has a 60 m spatial resolution, 212 spectral bands, and a 145 km swath width. This argument never considers information theory and the fact that there is a very high correlation between adjacent spectral intervals in the visible, near infrared, and short-wave infrared regions. This has been investigated with hyper-spectral data by Tucker and Maxwell (1976) and Tucker (1978) who found extremely high correlations between adjacent 5 nm spectral intervals in the visible and near-infrared spectral regions. These results have been further extended by Tucker and Sellers (1986).

The "hyper-spectral conundrum" results from the trade off between the number of spectral bands, spatial resolution, radiometric accuracy, and swath width or revisit frequency. It is difficult ir not impossible for a hyper-spectral instrument with hundreds of bands to have a 30 m spatial resolution and a short revisit frequency.

Tucker, C.J. and E.L. Maxwell, 1976. Sensor Design for Monitoring Vegetation Canopies. *Photogrammetric Engineering and Remote Sensing* 42(11):1399-1410.

Tucker, C. J. 1978. A Comparison of Satellite Sensor Bands for Vegetation Monitoring. *Photogrammetric Engineering and Remote Sensing* 44(11):1169-1180.

Tucker. C.J. and P.J. Sellers, 1986. Satellite remote sensing of primary



We have inter-calibrated Disaster Constellation Satellite bi-monthly data to the respective MODIS bands, atmospherically corrected these data to top-of-atmosphere surface reflectances, added a NDVI band, and done this from…

Table of Contents

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production. *International Journal of Remote Sensing* 7:1395-1416.

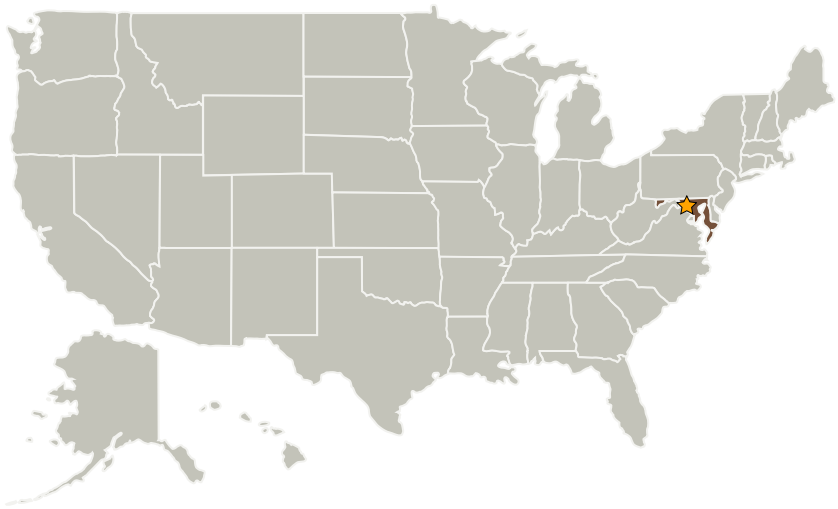
Anticipated Benefits

Our results will benefit the Landsat/Future Land Imaging Program as it decides to continue witn imagers or change to a hyper-spectral instrument.

This work benefits land imaging.

This project benefits the USGS, USDA, and all other federal agencies that use Landsat data to monitor land areas that are their responsibility.

Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Goddard Space Flight Center(GSFC)	Lead Organization	NASA Center	Greenbelt, Maryland

Co-Funding Partners	Type	Location
USDA Agricultural Research Service(USDA-ARS)	US Government	West Lafayette, Indiana

Organizational Responsibility

Responsible Mission Directorate:

Mission Support Directorate (MSD)

Lead Center / Facility:

Goddard Space Flight Center (GSFC)

Responsible Program:

Center Independent Research & Development: GSFC IRAD

Project Management

Program Manager:

Peter M Hughes

Project Manager:

Matthew J Mcgill

Principal Investigator:

Compton J Tucker

Technology Areas

Primary:

- TX08 Sensors and Instruments
  - TX08.1 Remote Sensing Instruments/Sensors
    - TX08.1.1 Detectors and Focal Planes

Center Independent Research & Development: GSFC IRAD

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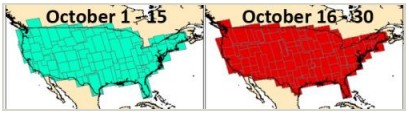
Primary U.S. Work Locations

Maryland

Images



Multi-Temporal vs. Hyper-Spectral Imaging
We have inter-calibrated Disaster Constellation Satellite bi-monthly data to the respective MODIS bands, atmospherically corrected these data to top-of-atmosphere surface reflectances, added a NDVI band, and done this from April through October of 20
(https://techport.nasa.gov/image/16733)

Links

GSC-17113-1
(https://ntts.arc.nasa.gov/app/)

Project Website:

http://sciences.gsfc.nasa.gov/sed/